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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
MARCEL GAUDET, ET AL.	: EXAMINER: STOUFFER, K. M.
SERIAL NO: 10/813,390	:
FILED: MARCH 31, 2004	: GROUP ART UNIT: 1762
FOR: SYSTEM AND METHOD OF REMOVING CHAMBER RESIDUES FROM A PLASMA PROCESSING SYSTEM IN A DRY CLEANING PROCESS	:

Appeal Brief Under 37 C.F.R. §41.31

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

This is an appeal from a final Office Action dated January 25, 2008. A Notice of Appeal was timely filed on May 27, 2008.

I. REAL PARTY IN INTEREST

The real party in interest in this appeal is TOKYO ELECTRON LIMITED at 3-1, Akasaka 5-chome, Minato-ku, Tokyo 107-6325, Japan.

II. RELATED APPEALS AND INTERFERENCES

Appellants, Appellants' legal representative and the assignees are aware of no appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF THE CLAIMS

Claims 1, 3-4, 7-8, and 10-30 are presently active in this case, stand finally rejected and are herein appealed.

IV. STATUS OF THE AMENDMENTS

No amendments have been made after final action in this case. The attached Appendix VIII reflects Claims 1, 3-4, 7-8, and 10-30 as presently pending on appeal.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

Claim 1 recites a method of removing fluoro-carbon polymer chamber residue from a plasma processing system (Appellants' specification at Fig. 8 and paragraph [0042]). The method includes introducing a process gas into a process chamber of the plasma processing system, the process gas consisting of CO, CO_2, or at least one of these molecules in combination with one or more of H_2, NH_3, H_2O, N_2 or an inert gas, and generating a plasma from the process gas (Appellants' specification at Fig. 8, steps 804-806 and paragraph [0042]; Figs 5-7 and paragraphs [0036]-[0039]). Also included is exposing the fluoro-carbon polymer chamber residue to the plasma in a waferless dry cleaning process to form a volatile reaction product from the residue, where a shield wafer is not provided on a substrate holder of the plasma processing system so that the substrate holder is cleaned by the waferless dry cleaning process (Appellants' specification at Fig. 8, step 808 and paragraph [0042]; paragraph 7 and paragraphs [0029]-[0030]). The reaction product is exhausted from the process chamber (Fig. 8, step 810 and paragraph [0042]).

Claim 27 recites a system for removing fluoro-carbon polymer chamber residue from a plasma processing system (Appellants' specification at Fig. 8 and paragraph [0042]). The system includes a gas introduction system configured to introduce a process gas into a

process chamber of the plasma processing system, the process gas consisting of CO, CO_2, or at least one of these molecules in combination with one or more of H_2, NH_3, H_2O, N_2 or an inert gas (Appellants' specification at Fig. 8, steps 804-806, Figs 5-7 and paragraphs [0036]-[0039]). Also included is a plasma generating system configured to generate a plasma from the process gas such that the fluoro-carbon polymer chamber residue is exposed to the plasma in a waferless dry cleaning process to form a volatile reaction product from the residue, where a shield wafer is not provided on a substrate holder of the plasma processing system so that the substrate holder is cleaned by the waferless dry cleaning process (Appellants' specification at Fig. 8, step 808 and paragraphs [0042], [0007] and [0029]-[0030]). An exhaustion system is configured to exhaust the reaction product from the process chamber (Appellants' specification at Fig. 8, step 810 and paragraph [0042].

Claim 28 recites a system for removing fluoro-carbon polymer chamber residue from a plasma processing system (Appellants' specification at Fig. 8 and paragraph [0042]). The system includes means for introducing a process gas into a process chamber of the plasma processing system, the process gas consisting of CO, CO_2, or at least one of these molecules in combination with one or more of H_2, NH_3, H_2O, N_2 or an inert gas (Appellants' specification at Figs 1-4, item 15; Fig. 8, steps 804-806 and paragraph [0042]). Also included is means for generating a plasma from the process gas such that the fluoro-carbon polymer chamber residue is exposed to the plasma in a dry cleaning process to form a volatile reaction product from the residue, where a shield wafer is not provided on a substrate holder of the plasma processing system so that the substrate holder is cleaned by the waferless dry cleaning process (Appellants' specification at Figs 1-4, item 35; Fig. 8, step 808 and paragraphs [0042], [0007] and [0029]-[0030]). Further included is means for exhausting the reaction product from the process chamber (Appellants' specification at Figs. 1-4, item 50; Fig. 8, step 810 and paragraph [0042].

VI. GROUNDS FOR REJECTION TO BE REVIEWED ON APPEAL

A. Claims 1, 3-4, 7-8, 10-23, and 27-30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,545,245 to Yeh et al. in view of patent application serial no. 2004/0109263 to Suda et al. and U.S. Patent No. 7,041,608 to Sieber et al. or U.S. Patent No. 6,057,247 to Imai et al., which is herein appealed.

VII. ARGUMENTS

A. Claims 1, 3-4, 7-8, 10-23, and 27-30 are not obvious under 35 U.S.C. § 103(a) over Yeh et al. in view of Suda et al. and Sieber et al. or Imai et al.

As noted above, Appellants' independent Claim 1 recites that the process gas "consisting of CO, CO_2, or at least one of these molecules in combination with one or more of H_2, NH_3, H_2O, N_2 or an inert gas." Independent Claims 27 and 28 recite similar features in system and means plus function claim format. Thus, CO, CO_2 (and possibly H_2O) are the only oxygen containing molecules that can be included in the claimed process gas and at least one of CO, CO_2 must be included in the claimed process gas. That is, the process gas in each of Claims 1, 27 and 28 cannot include O_2, which is the conventional plasma process. Figures 5-7 of Appellants' specification show a standard Argon plus O_2 plasma as a conventional baseline process to which other processes are compared. Further, curve 6 of Fig. 6 shows improved process results with the removal of O_2 at a process chamber pressure of 100 mTorr. As seen in Fig. 6, the use of O_2 provides acceptable results only in a process operated at the undesirable higher pressure of 600 mTorr. Thus, Appellants' specification shows the benefits of eliminating O_2 from the process gas. The Final Office Action admits that the primary reference to Yeh et al. does not disclose this feature, but apparently cites Suda et al., Sieber et al., and Imai et al. as teaching the CO/CO_2 limitation included in Claims 1, 27, and 28.

The cited reference to Suda et al. discloses a process for manufacturing a magnetic head device. As seen in Figures 6A-6G of Suda et al., the process includes etching a substrate using a dry etch O_2 plasma. Suda et al. also mentions that the dry etching steps for etching the substrate may be performed using "other gases that contain oxygen, such as CO, CO_2, NO, etc. that can generate oxygen plasma."[1] Thus, Suda et al. discloses a broad range of oxygen gases can be used to generate a plasma for etching ***a substrate*** device. However, there is no indication in Suda et al. that using CO and/or CO_2 in a plasma ***cleaning process*** for a semiconductor processing chamber provides any advantage over the broad range of possible gases including oxygen. In fact, Suda et al. does not disclose cleaning a process chamber at all. As discussed in Appellants' specification, the present inventors conducted experiments which led to the discovery that use of CO and/or CO_2 in the claimed process gas provides advantages for cleaning a process chamber. For example, Figures 5-7 of Applellants' specification show superior cleaning results from using a CO plasma. That is, of the many "oxygen containing gases" available, the present inventors discovered that CO and/or CO_2 process gases provide superior results for cleaning a processing chamber. Suda et al. does not teach this feature.

The cited references to Sieber et al. and Imai et al. do not correct the deficiencies of Suda et al. Sieber et al. discloses a method of making an electronic device. As seen in Figure 2 of this reference, the process includes creating an oxidizing plasma (step 24) to modify properties of the device electrode, and then depositing a fluorocarbon layer (step 26) on the electrode.[2] A post-deposition etch process can be used to remove fluorocarbon residue from the device before sealing and encapsulating the device. Sieber et al. further states that "plasmas containing oxygen process gas for cleaning the fluorocarbon residue may use plasmas containing oxygen or . . . use some combination of gases in the plasma such that

[1] Suda et al. at paragraph [0082].
[2] Sieber et al. at col. 10, lines 29-45.

fluorine is removed (e.g. in the form of HF) from the fluorocarbon and the remaining carbon-bearing materials oxidized to produce volatile species such as CO and CO_2."[3] Thus, as with Suda et al. discussed above, Sieber et al. discloses that an oxygen containing plasma can be used to process a substrate. While Sieber et al. mentions CO and CO_2, these are only ***byproducts*** of the substrate cleaning process, and not used as the process gas itself.

Finally, the cited reference to Imai et al. discloses a method for controlling the environment inside a reaction chamber of a dry etching apparatus. As seen throughout Imai et al., undesirable fluorine is removed from the reaction chamber by generating oxygen plasma in the reaction chamber. In particular, column 19, lines 19-21 of Imai et al. states, "carbon oxide and oxygen gases are introduced into the reaction chamber 107 at respective flow rates of 200 sccm or more and 80 sccm or more (in step S305)." Thus, Imai et al. does not disclose process gas "consisting of CO, CO_2, or at least one of these molecules in combination with one or more of H_2, NH_3, H_2O, N_2 or an inert gas" as recited in independent Claims 1, 27 and 28.

In addition, Claims 1, 27 and 28 recite that the exposing includes a waferless dry cleaning process where a shield wafer is not provided on a substrate holder of a plasma processing system so that the substrate holder is cleaned by the waferless dry cleaning process. As discussed in Appellants' specification, the claimed cleaning process allows improved cleaning of the substrate holder so that particulate contamination will not occur in processed wafers. Yeh et al. merely mentions the possibility of a waferless chamber conditioning process without any indication that this is advantageous. Further, as noted above the references to Suda et al. and Sieber et al. disclose processing of a substrate. Similarly, the reference to Imai et al. is primarily directed to cleaning a polymer film from a feature in a substrate (see for example Figures 1a-1d, 5a-5b, 9a-9d, and 24a-24d). That is,

[3] Sieber et al. at col. 11, lines 10-20.

Suda et al., Sieber et al. and Imai et al. disclose processes wherein a wafer is present on the substrate holder. Based on this, Appellants respectfully submit that one of ordinary skill in the art would not select the merely mentioned waferless process of Yeh et al. and then modify this process using any of the process parameters of Suda et al., Sieber et al., or Imai et al., which are not waferless processes.

For the reasons discussed above, independent Claims 1, 27 and 28, and claims depending therefrom, are patentable over the cited references.

Nevertheless, Appellants' submit that dependent Claims 29 and 30 further distinguish the claimed invention over the cited references. Specifically, Claim 29 specifies that the process gas consists of CO, CO_2 or at least one of these molecules in combination with an inert gas. Claim 30 recites that the process gas consists of pure CO, or CO in combination with Argon. That is, Claims 29 and 30 further limit the process gas to including an inert gas and Argon respectively. The cited prior art references also do not disclose these features. As noted above, Figures 5-7 show the superior results provided by pure CO or CO in combination with Argon. Thus, Appellants' Claims 29-30 provide additional basis for patentability over the cited references.

B. Conclusion

For the reasons discussed above, the rejection of Claims 1, 3-4, 7-8, and 10-30 is improper and should be withdrawn.

Respectfully submitted,

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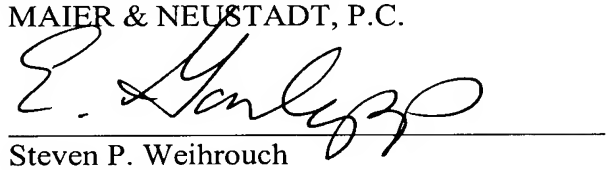

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VIII. CLAIMS APPENDIX

Claim 1: A method of removing fluoro-carbon polymer chamber residue from a plasma processing system, comprising:

introducing a process gas into a process chamber of the plasma processing system, the process gas consisting of CO, CO_2, or at least one of these molecules in combination with one or more of H_2, NH_3, H_2O, N_2 or an inert gas;

generating a plasma from the process gas;

exposing the fluoro-carbon polymer chamber residue to the plasma in a waferless dry cleaning process to form a volatile reaction product from the residue, where a shield wafer is not provided on a substrate holder of the plasma processing system so that the substrate holder is cleaned by the waferless dry cleaning process; and

exhausting the reaction product from the process chamber.

Claim 3: The method according to claim 1, wherein the exposing further comprises providing a substrate on a substrate holder in the process chamber.

Claim 4: The method according to claim 1, further comprising performing at least one manufacturing process in the process chamber before repeating the introducing, generating, exposing, and exhausting.

Claim 7: The method according to claim 1, wherein the introducing a process gas comprises introducing an inert gas containing at least one of Ar, He, or Xe.

Claim 8: The method according to claim 1, wherein the introducing comprises flowing the process gas at a gas flow rate between about 100 sccm and about 5,000 sccm.

Claim 10: The method according to claim 1, wherein the introducing comprises flowing the at least one of CO or CO_2 at a gas flow rate between about 100 sccm and about 2,000 sccm.

Claim 11: The method according to claim 1, wherein the introducing comprises flowing the at least one of H_2, NH_3, H_2O, or N_2 at a gas flow rate between about 20 sccm and about 1000 sccm.

Claim 12: The method according to claim 1, wherein the introducing comprises flowing the inert gas at a gas flow rate less than about 2,000 sccm.

Claim 13: The method according to claim 1, wherein the introducing further comprises maintaining a pressure between about 10 mTorr and about 5 Torr in the process chamber.

Claim 14: The method according to claim 1, wherein the introducing further comprises maintaining a pressure between about 20 mTorr and about 1 Torr in the process chamber.

Claim 15: The method according to claim 1, wherein the plasma processing system comprises upper and lower electrodes, and wherein the generating comprises applying RF

frequency between about 1 MHz and about 100 MHz and RF power between about 100 W and about 4,000 W to the electrodes.

Claim 16: The method according to claim 15, wherein the RF frequency applied to the upper electrode is between about 40 MHz and about 80 MHz and the RF power applied to the upper electrode is between about 600 W and about 900 W, and wherein the RF frequency applied to the lower electrode is between about 1 MHZ and about 3 MHz and the RF power applied to the lower electrode is between about 100 W and about 400 W.

Claim 17: The method according to claim 1, wherein the exposing is carried out for a time period between about 2 seconds and about 240 seconds.

Claim 18: The method according to claim 1, wherein the exposing is carried out for a time period between about 15 seconds and about 40 seconds.

Claim 19: The method according to claim 1, further comprising:

monitoring a signal from the plasma processing system, the signal being indicative of the progress of the dry cleaning method; and

based upon the signal, performing one of the following:

(a) continue performing the dry cleaning process and continue monitoring, or

(b) stopping the cleaning process.

Claim 20: The method according to claim 19, wherein the monitoring further comprises determining if an intensity level of the signal has reached a threshold value.

Claim 21: The method according to claim 20, wherein performing (b) occurs after determining that the threshold value has been reached.

Claim 22: The method according to claim 19, wherein the monitoring comprises using an optical monitoring system to detect light emission from the process chamber.

Claim 23: The method according to claim 22, wherein the monitoring comprises monitoring emitted that light originates from at least one of carbon monoxide, fluorine, or silicon tetrafluoride.

Claim 24: The method according to claim 19, wherein the monitoring comprises using a mass sensor to detect a mass signal of a gas in the process chamber.

Claim 25: The method according to claim 19, wherein the monitoring comprises using a particle monitoring system to detect particle levels in the process chamber.

Claim 26: The method according to claim 19, wherein the monitoring comprises using a process parameter including at least one of RF generator peak-to-peak voltage or capacitor position in an impedance match network to detect a plasma condition in the process chamber.

Claim 27: A system for removing fluoro-carbon polymer chamber residue from a plasma processing system, comprising:

a gas introduction system configured to introduce a process gas into a process chamber of the plasma processing system, the process gas consisting of CO, CO_2, or at least one of these molecules in combination with one or more of H_2, NH_3, H_2O, N_2 or an inert gas;

a plasma generating system configured to generate a plasma from the process gas such that the fluoro-carbon polymer chamber residue is exposed to the plasma in a waferless dry cleaning process to form a volatile reaction product from the residue, where a shield wafer is not provided on a substrate holder of the plasma processing system so that the substrate holder is cleaned by the waferless dry cleaning process; and

a exhaustion system configured to exhaust the reaction product from the process chamber.

Claim 28: A system for removing fluoro-carbon polymer chamber residue from a plasma processing system, comprising:

means for introducing a process gas into a process chamber of the plasma processing system, the process gas consisting of CO, CO_2, or at least one of these molecules in combination with one or more of H_2, NH_3, H_2O, N_2 or an inert gas;

means for generating a plasma from the process gas such that the fluoro-carbon polymer chamber residue is exposed to the plasma in a dry cleaning process to form a volatile reaction product from the residue, where a shield wafer is not provided on a substrate holder of the plasma processing system so that the substrate holder is cleaned by the waferless dry cleaning process; and

means for exhausting the reaction product from the process chamber.

Claim 29: The method of claim 1, wherein the process gas consists of CO, CO_2 or at least one of these molecules in combination with an inert gas.

Claim 30: The method of claim 29, wherein the process gas consists of pure CO, or CO in combination with Ar.